**Lesson Two: “***Converting Numbers into Exponential Products”*

**Integer Exponents:** Positive and Negative Powers

**Positive Exponents**

In this example, our base is 3, and our exponent is 5. This tells us to multiply the number three, by itself, five times.

An exponent tells us how many times to multiply the base number.

= 3 ∙ 3 ∙ 3 ∙ 3 ∙ 3 = 243

REMEMBER: Exponents only expand what they directly touch!

**Note:** Multiplication is repeated addition, so:

**Exponents** are repeated *multiplication*, so:

**Negative Exponents**

A negative exponent is not what it seems…

It is not possible to expand our base of *2*, negative *3* times as we would with positive exponents. Negative exponents mean we have an extra job to do before we can expand them.

The negative sign tell us that the number (with its exponent) is in the wrong place…**They need to move.**Consider a number with a negative exponent as being unhappy where he is. He who has the negative exponent is in the wrong/opposite location. To fix this, imagine there is a top and bottom (upstairs and downstairs), and once you move the number to its opposite location it will be happy.

**Important Vocabulary**

**Prime Number:**

A **prime number** can be *divided* evenly only by 1 or itself.

It must be a whole number greater than 1.

The first few *prime numbers* are: 2, 3, 5, 7, 11, 13, and 17.

**Factors:**

Factors are the numbers you **multiply** together to get *another number*

**FACTOR**

**For example:**

2 ∙ 3 = 6

**FACTOR**

Therefore, the factors of 6 are 2 and 3.

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**Prime Factorization:**

"Prime Factorization" is finding **which prime numbers** *multiply*

together to make the *original number*.

**For example**:

It is true that 4 ∙ 3 = 12. However, 4 is not prime, it can be broken down some more…

What are the factors of 12?

12 = 4 ∙ 3

*So…*

12 = 4 ∙ 3 = 2 ∙ 2 ∙ 3

Therefore the *factors* of **12** are 2, 2, and 3.

**Prime Factorization & Exponents:** Using Prime Factorization to Rewrite in Exponential Form

**Problem 1**: What is the prime factorization of **147**?

147 = 7 ∙ 21 = 7 ∙ 7 ∙ 3

Therefore, the factors of 147 are **7**, **7** and **3**. These prime factors are unique to the number *147*.

**Step 1**: Create a factor tree for the given number

**Step 2**: Group the common factors

**Step 3**: Rewrite using exponent notation

**Step 4**: Check solution

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**Problem 2:** Write 144 as a product of its prime factors.

144 = 12 ∙ 12 = 3 ∙ 4 ∙ 3 ∙ 4 = 3 ∙ 2 ∙ 2 ∙ 3 ∙ 2 ∙ 2

The factors of *144* are *3, 3, 2, 2, 2,* and *2.*

Now we need to **express 144** as a product of its prime factors. This where our *properties of exponents* come into play.

3 ∙ 3 = 32 and 2 ∙ 2 ∙ 2 ∙ 2 = 24

**Solution:**  32 ∙ 24

We can **check** our solution by multiplying our numbers together. Does 32 ∙ 24  = 144?

32 ∙ 24  = 9 ∙ 16 = 144 ☺ Yes!!

**Problem 3**: Write 1/81 as a product of its prime factors.

Remember our special friend the negative exponent!

**Problem 4**: Write 9/625 as a product of its prime factors.